

Claims

- 1 1. A quantum information processing element comprising
2 a cage defining a cavity formed from a plurality of self-assembling protein molecules,
3 and
4 one or more cargo elements located within the cavity, wherein at least one of the cargo
5 elements comprises a qubit programmable into a plurality of logical states.
- 1 2. A quantum information processing element according to claim 1, comprising receptors
2 for capturing and positioning one or more cargo elements within the cavity.
- 1 3. A quantum information processing element according to claim 2, comprising a vesicle
2 located within the cage and enclosing one or more cargo elements, wherein the receptors extend
3 through the vesicle to capture and position a cargo element within the vesicle.
- 1 4. A quantum information processing element according to claim 3, comprising adaptors
2 disposed between the receptors and the cage and binding to the receptors.
- 1 5. A quantum information processing element according to claim 1, comprising a vesicle
2 located within the cage and enclosing the one or more cargo elements.
- 1 6. A quantum information processing element according to claim 1, comprising molecular
2 tethers for capturing and positioning one or more cargo elements within the cavity.
- 1 7. A quantum information processing element according to claim 1, comprising direct cage
2 bonding for capturing and positioning one or more cargo elements within the cavity.
- 1 8. A quantum information processing element according to claim 1, comprising receptors,
2 molecular tethers and direct cage bonding for capturing and positioning one or more cargo
3 elements within the cavity.
- 1 9. A quantum information processing element according to claim 1, comprising one or more
2 cargo elements forming a non-permeable cavity.
- 1 10. A quantum information processing element according to claim 3, comprising a vesicle
2 forming a non-permeable cavity.
- 1 11. A quantum information processing element according to claim 1, comprising a self-
2 assembling cage that is electrically neutral and inhibits charge transfer between the cage and its
3 enclosed cargo elements.

- 1 12. A quantum information processing element according to claim 1, comprising a self-
2 assembling cage that reduces the tendency of a plurality of logical states in a coherent state to
3 collapse into a decoherent state.
- 1 13. A quantum information processing element according to claim 1, comprising a non-qubit-
2 only cage that inhibits non-quantum information processing cargo elements from interfering with
3 qubit cargo element operation in other cages.
- 1 14. A quantum information processing element according to claim 3, comprising a self-
2 assembling vesicle that is electrically neutral and inhibits charge transfer between the vesicle and
3 its enclosed cargo elements.
- 1 15. A quantum information processing element according to claim 3, comprising a self-
2 assembling insulative vesicle that reduces the tendency of a plurality of logical states in a
3 coherent state to collapse into a decoherent state.
- 1 16. A quantum information processing element according to claim 4, comprising self-
2 assembling receptors and adaptors that are electrically neutral and inhibit charge transfer
3 between the vesicle and cage and their enclosed cargo elements.
- 1 17. A quantum information processing element according to claim 1, comprising a self-
2 assembling cage that reduces contaminant background radiation to cargo carried within the cage.
- 1 18. A quantum information processing element according to claim 3, comprising a self-
2 assembling vesicle that reduces contaminant background radiation to cargo carried within the
3 vesicle.
- 1 19. A quantum information processing element according to claim 1, comprising a self-
2 assembling framework of cages to structurally support one or more self-assembling QIP
3 elements.
- 1 20. A quantum information processing element according to claim 1, comprising a self-
2 assembling electrically neutral substrate of cages to structurally support one or more self-
3 assembling QIP elements.
- 1 21. A quantum information processing element according to claim 1, comprising a self-
2 assembling framework of cages to structurally order one or more self-aligning QIP elements.
- 1 22. A quantum information processing element according to claim 1, wherein a cage is empty
2 and includes no cargo elements.

- 1 23. A quantum information processing element according to claim 1, wherein the one or
2 more cargo elements is a single cargo element comprising a qubit programmable into a plurality
3 of logical states.
- 1 24. A quantum information processing element according to claim 1, wherein the one or
2 more cargo elements are a plurality of cargo elements.
- 1 25. A quantum information processing element according to claim 24, wherein the plurality
2 of cargo elements are qubits programmable into a plurality of logical states.
- 1 26. A quantum information processing element according to claim 24, wherein at least some
2 of the plurality of cargo elements are quantum information processing cargo elements
- 1 27. A quantum information processing element according to claim 24, wherein at least some
2 of the plurality of cargo elements are non-quantum information processing cargo elements.
- 1 28. A quantum information processing element according to claim 1, wherein the cargo
2 elements respond to stimuli internal and external to the cage.
- 1 29. A quantum information processing element according to claim 3, wherein a vesicle and
2 its contained cargo elements respond to stimuli internal and external to the vesicle.
- 1 30. A quantum information processing element according to claim 24, wherein a subset of the
2 non-quantum information processing cargo elements include one or more therapeutic agents.
- 1 31. A quantum information processing element according to claim 24, wherein a subset of
2 the non-quantum information processing cargo elements include one or more diagnostic agents.
- 1 32. A quantum information processing element according to claim 24, wherein a subset of
2 non-quantum information processing cargo elements include one or more sensor agents.
- 1 33. A quantum information processing element according to claim 24, wherein a subset of
2 non-quantum information processing cargo elements include one or more prosthetic agents.
- 1 34. A quantum information processing element according to claim 24, wherein a subset of
2 qubit and non-quantum information processing cargo elements include one or more quantum
3 dots.
- 1 35. A quantum information processing element according to claim 24, wherein a subset of
2 the cargo elements include one or more photonic dots.
- 1 36. A quantum information processing element according to claim 24, wherein a subset of
2 the cargo elements include one or more liquids without dopants or with one or more dopants of
3 any suitable type.

1 37. A quantum information processing element according to claim 24, wherein a subset of
2 the cargo elements include a gas or vapor without dopants or with one or more dopants of any
3 suitable type.

1 38. A quantum information processing element according to claim 1, wherein one or more
2 qubit cargo elements are programmed by one or more pulses of electromagnetic radiation.

1 39. A quantum information processing element according to claim 38, wherein the
2 electromagnetic radiation has a frequency in the UHF region.

1 40. A quantum information processing element according to claim 38, wherein the
2 electromagnetic radiation has a frequency in the microwave region.

1 41. A quantum information processing element according to claim 38, wherein the
2 electromagnetic radiation has a frequency in the radio region.

1 42. A quantum information processing element according to claim 1, wherein the qubit
2 includes an unpaired electron and the plurality of logical states of the qubit are defined by
3 electron spin polarization.

1 43. A quantum information processing element according to claim 1, wherein the qubit
2 includes a nucleus and the plurality of logical states of the qubit are defined by nucleus spin
3 polarization.

1 44. A quantum information processing element according to claim 1, wherein the qubit
2 includes an unpaired electron and the plurality of logical states of the qubit are defined relative to
3 an energy difference.

1 45. A quantum information processing element according to claim 1, wherein the qubit
2 includes a nitroxide molecule.

1 46. A quantum information processing element according to claim 1, wherein the qubit
2 includes a free radical molecule.

1 47. A quantum information processing element according to claim 1, wherein the qubit is
2 photon-based and the plurality of logical states of the photon-based qubit include a coherent
3 logical state.

1 48. A quantum information processing element according to claim 1, wherein the plurality of
2 logical states includes a coherent state.

1 49. A quantum information processing element according to claim 1, wherein the plurality of
2 logical states includes a coherent state at room temperature.

- 1 50. A quantum information processing element according to claim 1, wherein the self-
2 assembling protein molecule is a clathrin molecule.
- 1 51. A quantum information processing element according to claim 1, wherein the cage
2 comprises self-assembling synthetic protein molecules.
- 1 52. A quantum information processing element according to claim 4, wherein receptors,
2 adaptors, and vesicle comprise natural or synthetic protein molecules.
- 1 53. A quantum information processing element according to claim 1, comprising a metallic
2 coating on part or the entirety of the cage.
- 1 54. A quantum information processing element according to claim 4, comprising a metallic
2 coating on a portion or an entirety of the receptors, adaptors, and vesicle.
- 1 55. A quantum information processing element according to claim 1, wherein the cage is
2 substantially greater than one nanometer in diameter.
- 1 56. A quantum information processing element according to claim 1, wherein the cage is at
2 least about 50 nanometers in diameter.
- 1 57. A quantum information processing element according to claim 1, wherein the cage is at
2 least about 100 nanometers in diameter.
- 1 58. A quantum information processing element according to claim 1, wherein the cage is
2 symmetric with respect to a plane.
- 1 59. A quantum information processing element according to claim 1, wherein the cage has
2 icosahedral geometry.
- 1 60. A quantum information processing element according to claim 1, wherein qubits are
2 linearly positioned at vertices along a single plane using circulant ordering.
- 1 61. A quantum information processing element according to claim 1, wherein multiple
2 quantum information processing elements are physically linked together.
- 1 62. A quantum information processing element according to claim 1, wherein multiple self-
2 assembling QIP elements are functionally linked together, either locally or at a distance.
- 1 63. A quantum information processing element according to claim 1, wherein the quantum
2 information processing element forms a hybrid system upon its physical or functional integration
3 with non-invention elements in vitro and in vivo.
- 1 64. A method for forming a quantum information processing element comprising

2 forming from self-assembling protein molecules a cage defining a cavity, and locating
3 one or more cargo elements within the cavity, wherein
4 at least one of the cargo elements comprises a qubit programmable into a plurality of
5 logical states.